

星間起源のアミノ酸とその前駆体の初期太陽系での小天体内部における 安定性

Stability of Amino Acids and Their Precursors of Interstellar Origin in the Interiors of Small Bodies in Early Solar System

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星間環境において、分子雲の氷微粒子は生命の原材料となりうる有機物の形成に適した場所の一つとして挙げられる。分子雲を構成する星間塵の核の周りに水や一酸化炭素などの分子が凍結したアイスマントルへ宇宙線などが照射することでアミノ酸などが生成したと考えられる。

先行研究の分子雲を模擬した実験では、高分子アミノ酸前駆体が非生物的に生成することが示された¹⁾。分子雲で生成したアミノ酸前駆体は太陽系誕生時に始原始的な小天体内部に取り込まれ、²⁶Alの放射性崩壊による γ 線や熱の影響を受けた可能性がある。

これらを考慮して、本研究ではアミノ酸と分子雲起源のアミノ酸前駆体の γ 線に対する安定性を調べるための実験を行なった。結果として分子雲由来の高分子アミノ酸前駆体は小天体内部を模擬した環境下でも、 γ 線照射に対して遊離のアミノ酸より安定的であることが確認出来た。

In the interstellar environment, icy dust particles in molecular clouds are one of the most suitable sites for prebiotic molecular formation. Organic compounds including amino acids are thought to have been produced by galactic cosmic ray irradiation in the ice mantle around the nucleus of dust particles in molecular clouds.

Previous studies have shown that macromolecular amino acid precursors (CAW) are produced abiotically in experiments simulating molecular clouds¹⁾. It was possible that the amino acid precursors produced in interstellar molecular clouds were incorporated into the primitive small bodies during the solar system formation, and were affected by γ -rays and heat from the radioactive decay of ²⁶Al.

Considering these factors, experiments were conducted to investigate the stability of amino acids and macromolecular amino acid precursors against γ -rays in the interior of small bodies. Glycine or CAW was dissolved in ammonia water or in a mixture of formaldehyde, ammonia, and water, and was irradiated by γ -rays from ⁶⁰Co source. The results showed that macromolecular amino acid precursors from molecular clouds were more stable than free amino acids against γ -ray irradiations, in an environment that simulates the interior of small bodies.

References

- 1) Takano, Y., Marumo, K., Yabashi, S., Kaneko, T., Kobayashi, K.: Pyrolysis of Complex Organics Following High-Energy Proton Irradiation of Simple Inorganic Gas Mixture. Appl. Phys. Lett., 85 (2004) pp.1633-1635.